



**MARINE AIR-CONDITIONING
HEATING AND VENTILATION SYSTEMS**

User manual

Chiller A15



Table of Contents

1	Introduction	3
2	Safety precautions	4
3	General description.	5
4	Dimensions	6
5	Installation of the chiller unit	7
6	Chiller fluid connections	8
7	Fluid system	10
8	Cooling water system	11
9	Electric connection locations	12
10	Electric connections	13
11	Electric connections power supply	14
12	Electric connections pump and flow switch	15
13	Electric connections ext. heater and valve	16
14	Electric control connections	18
15	Display settings.	21
16	Maintenance.	24
17	Location components.	28
18	Technical data	30
19	Environmental Information.	31

Annex:

Declaration of Conformity

Pressure test certificate

Test report

1. Introduction

This manual contains detailed instructions and notes for the installation, operation and use of the chiller unit(s) as mentioned on the title page. For your safety and benefit, read this manual carefully before using the machine. Keep this manual in a place so that it can be consulted when necessary.



Read this manual thoroughly. Become familiar with the machine's components and Features. The installation of a chiller unit is a very important step of insuring that the equipment operates in a trouble-free manner. Follow the instructions for the initial installation of the machine to avoid service problems.

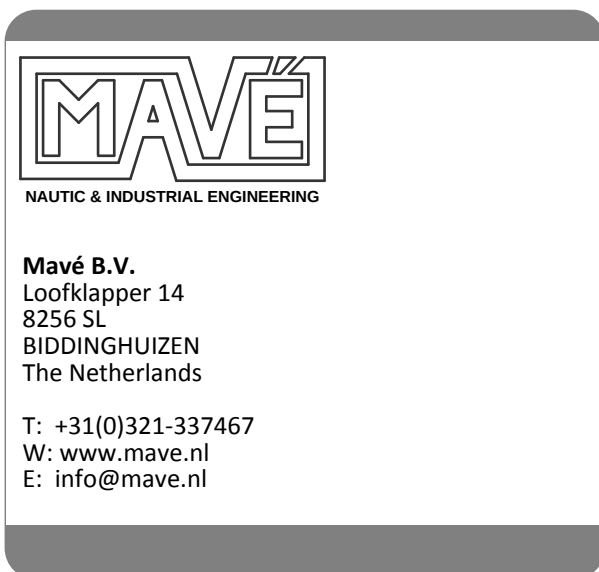
The manufacturer assumes no responsibility for personal injury or property damage resulting from improper or unsafe practices during the handling, installation, service, or operation of the equipment.



Maintenance or repair work should always be carried out by qualified people. Whenever changes have been made to the original design of the chiller unit will make the warrantee void, in these cases Mavé will not be responsible for possible damages. All risks are then exclusively for the user.

NOTE:

If you have any questions concerning the information in the manual, replacement parts or the operation of the fan coil unit, then please contact your supplier or:



2. Safety precautions

The equipment covered by this manual is designed for safe and reliable operation when installed and operated within its design specification limits. To avoid personal injury or damage to equipment or property while installing or operating this equipment, it is essential that qualified, experienced personnel perform these activities using good judgment and safe practices.

Be aware that system pressure and electrical components, reparations and maintenance on this system can be hazardous. When working on this equipment, always observe precautions described in the manual and safety markings on the product.



Electrical shock

All power must be disconnected prior to installation and servicing this equipment. More than one source of power may be present. Disconnect all power sources to avoid electrocution or shock injuries.



Rotating parts

The fan must be disconnected prior to opening access panels. Motors can start automatically, disconnect all power and control circuits prior to servicing to avoid serious crushing or dismemberment injuries.



Hot parts

Electric Resistance heating elements must be disconnected prior to servicing. Electric heater elements may start automatically, disconnect all power and control circuits prior to servicing to avoid burns.

- Safety Recommendations



- Always wear work gloves and a safety goggle.



- When working with electrical tools, wear ear protection.



- Make sure a fire extinguisher is close to the work area.



- Before repairing or maintaining the system, switch off voltage at main panel or power source before opening any cover. Failure to comply may result in serious injury!



- To minimize the hazard of electrical shock and personal injury, this component must be effectively grounded.



- Only connect wires according to the circuit diagrams as shown in the system manual or system drawings.

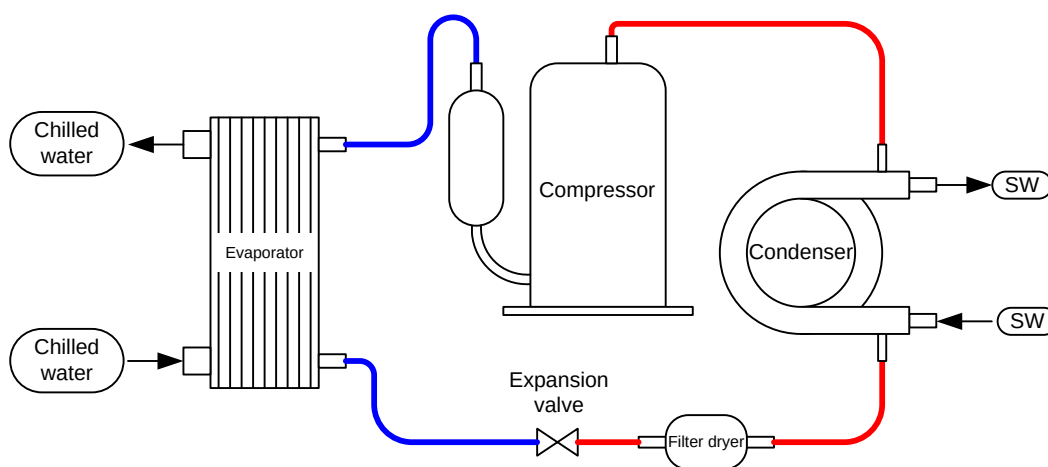
3. General description

The chiller unit is an electric powered water cooled chiller unit which is designed for boat applications. The unit contains a compressor, condenser and an evaporator. The compressor is of the on/off type which switches on or off depending on the temperature of the chilled water. The sea water system is equipped with corrosion resistant materials Such as stainless steel and copper nickel to secure a long life time. The evaporator is a brazed plate type which is made from stainless steel and brazed with copper.

Working principle:

The compressor will pressurize the cooling refrigerant in the system. The heat of this pressurized gas shall be cooled down via the condenser by the sea water which is flowing through condenser. Due to the temperature decrease by the cold sea water, the hot gas will be converted to liquid. The high pressure liquid refrigerant entering the expansion valve is quite warm. The expansion valve removes the pressure from the liquid refrigerant to allow expansion from a liquid to vapour. Due to this fast pressure drop the refrigerant turns very cold when it enters the evaporator. The evaporator will transfer the very low temperature to the chilled water system.

The unit is designed to keep the outgoing chilled water temperature level to the set temperature which will be set in the display of the chiller unit. The fan coil units absorb the heat from the area's where they are installed, the heat will be transferred by chilled water pipes to the chiller unit(s).



IMPORTANT TO READ BEFORE INSTALLATION!

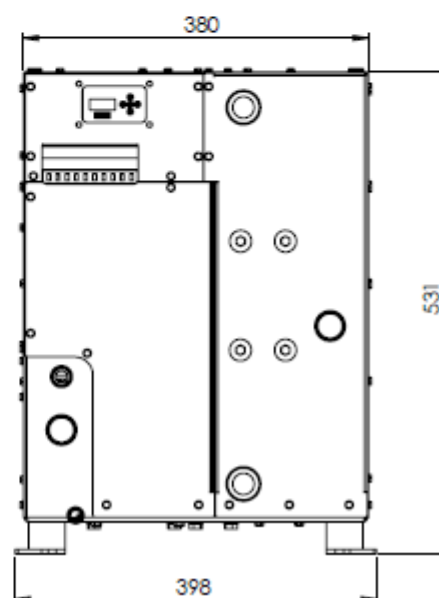
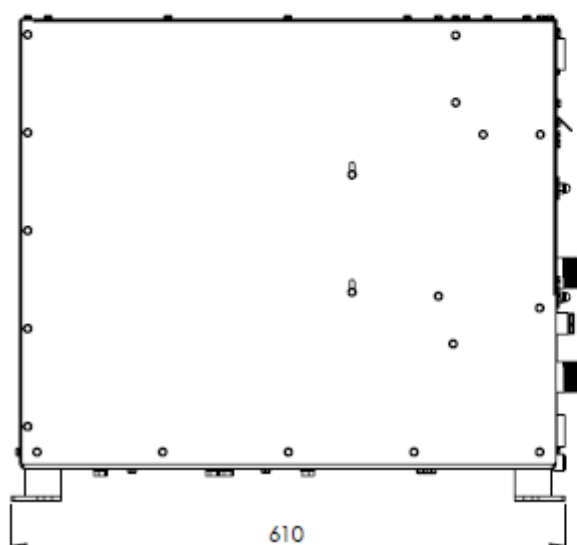
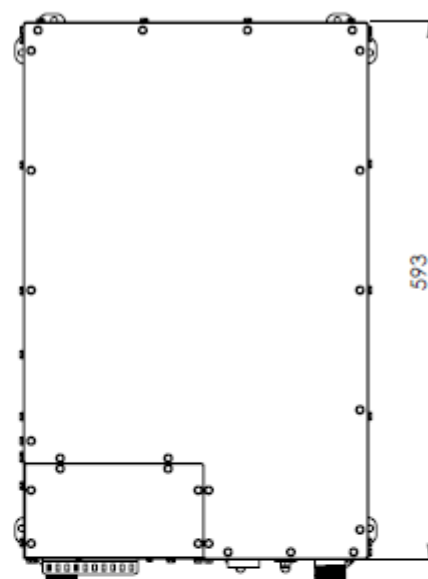
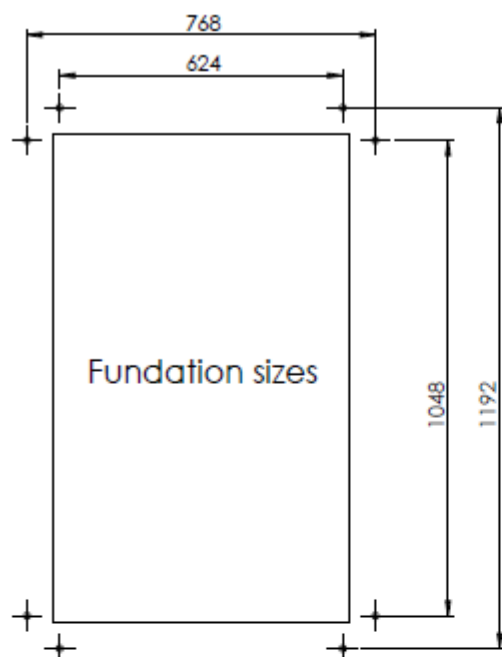
Electrical;

Most MAR-IX products have 2 separate power supply's, one 24Vdc and one 230Vac or 400Vac. The 24Vdc is for control the chiller unit and for memory and communication. The 230Vac or 400Vac is to supply the compressor and pumps. Without one of the power supplies the system will not function.

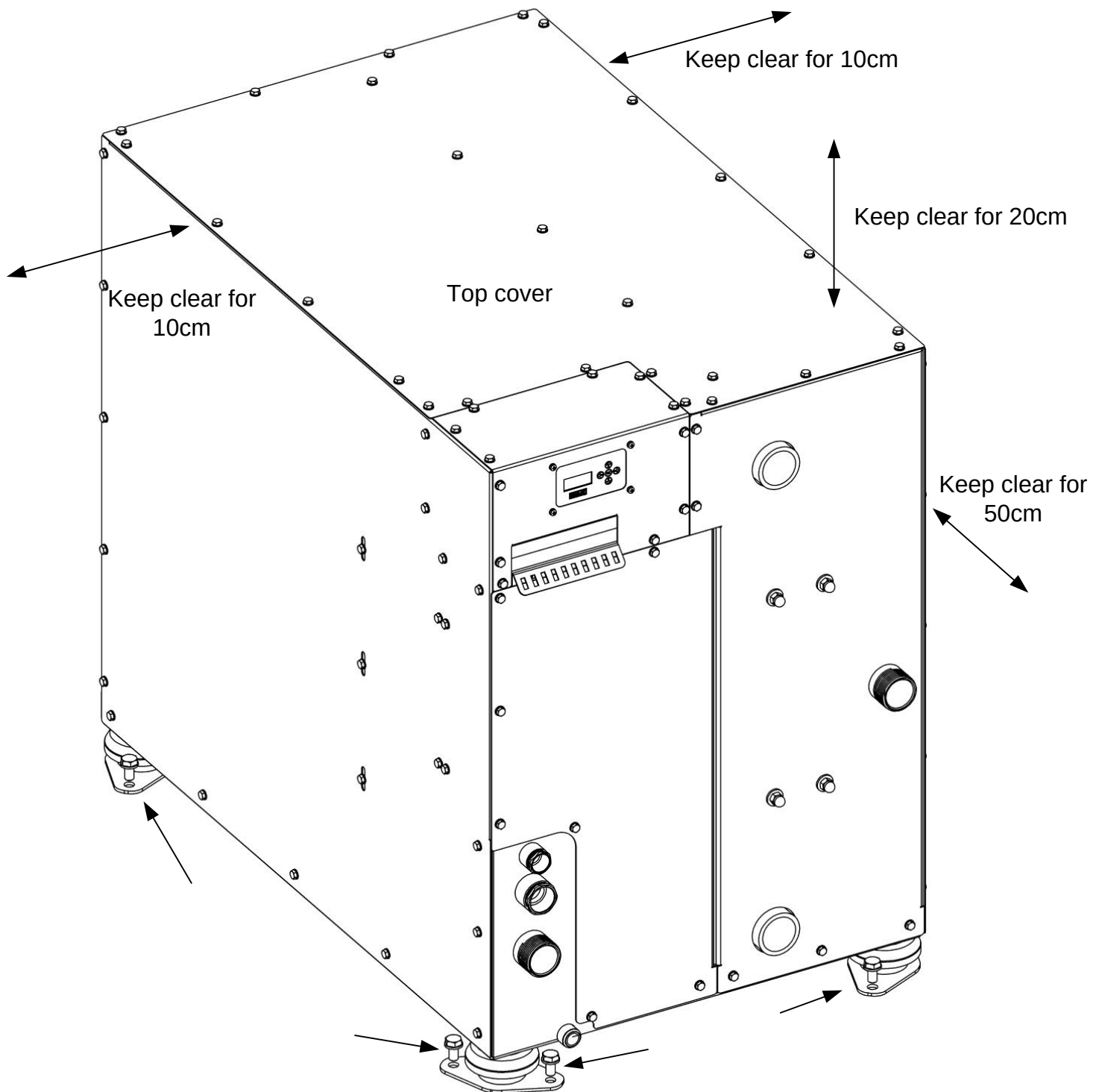
External components/equipment;

External components like pumps, fancoil units, heaters, etc are not fully described in this manual. Please use the specific manuals of these components for a proper installation.

4. Dimensions



5. Installation of the chiller unit

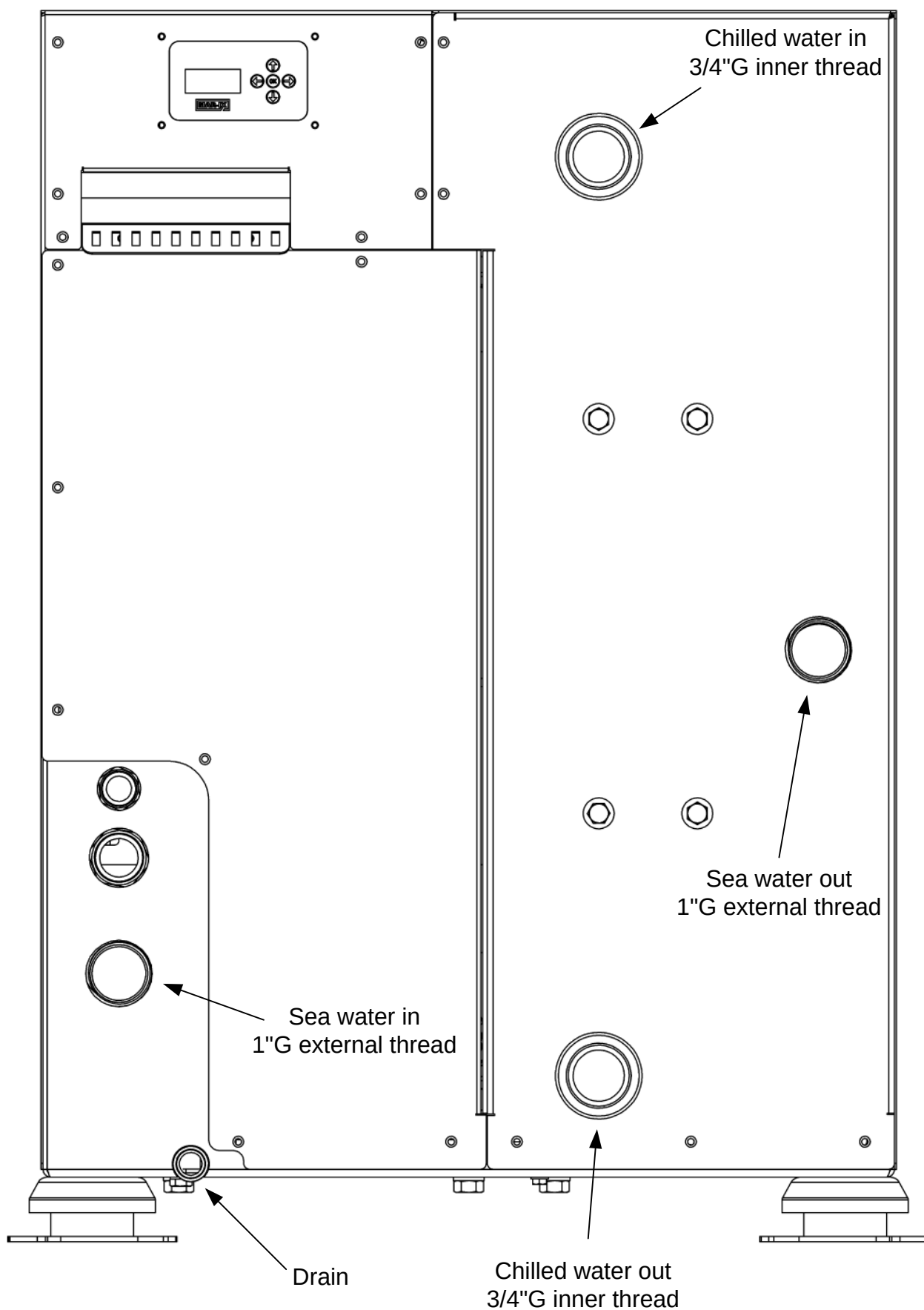


Choose a place for the chiller unit in a technical area or the engine room. Keep the front of the unit free for mounting the fluid piping and electrical wiring.

For maintenance or repair we advise to keep the front clear from other equipment and make it possible that the top cover can be removed. We advise to keep the top of the unit clear for around 20cm.

Place the chiller unit on a solid underground which can bare the weight of the unit and fix the unit with 8 bolts to the floor.

6. Chiller fluid connections

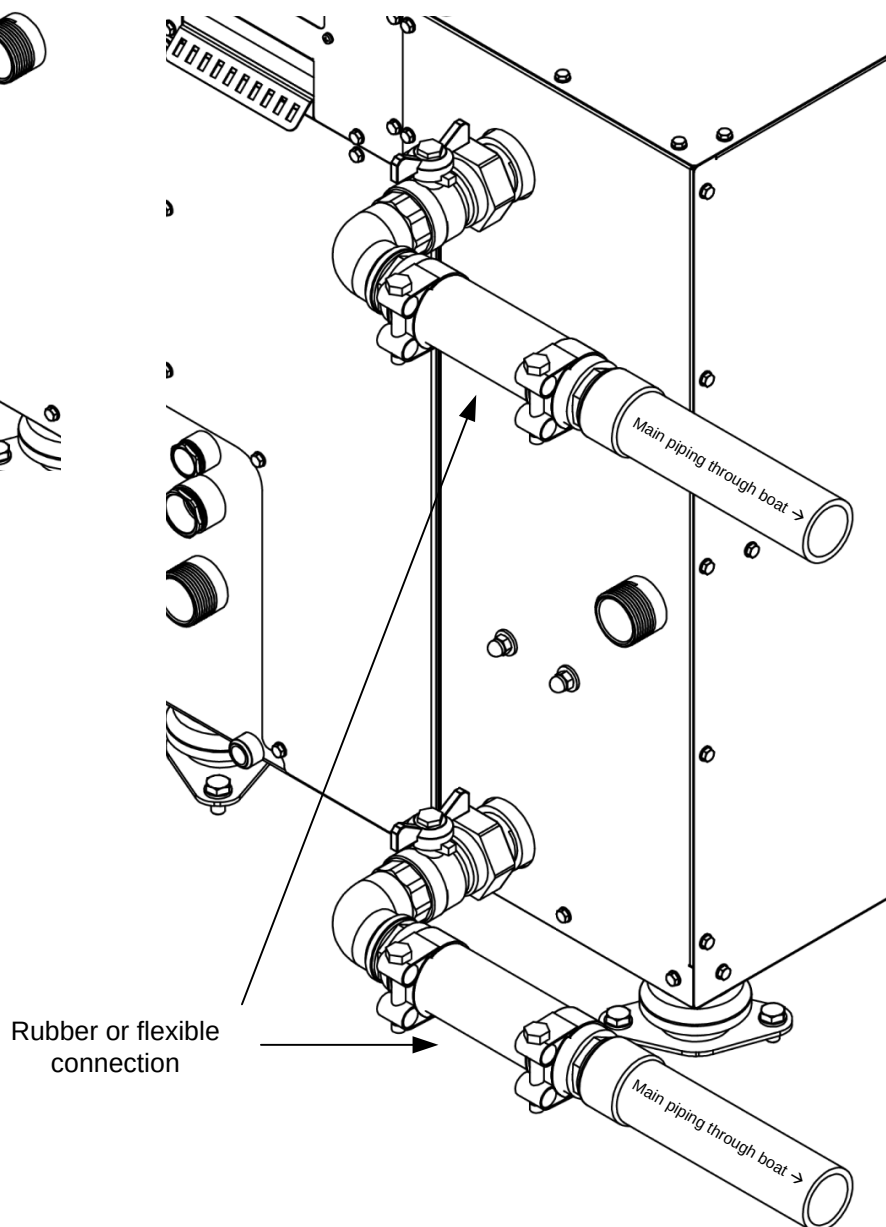
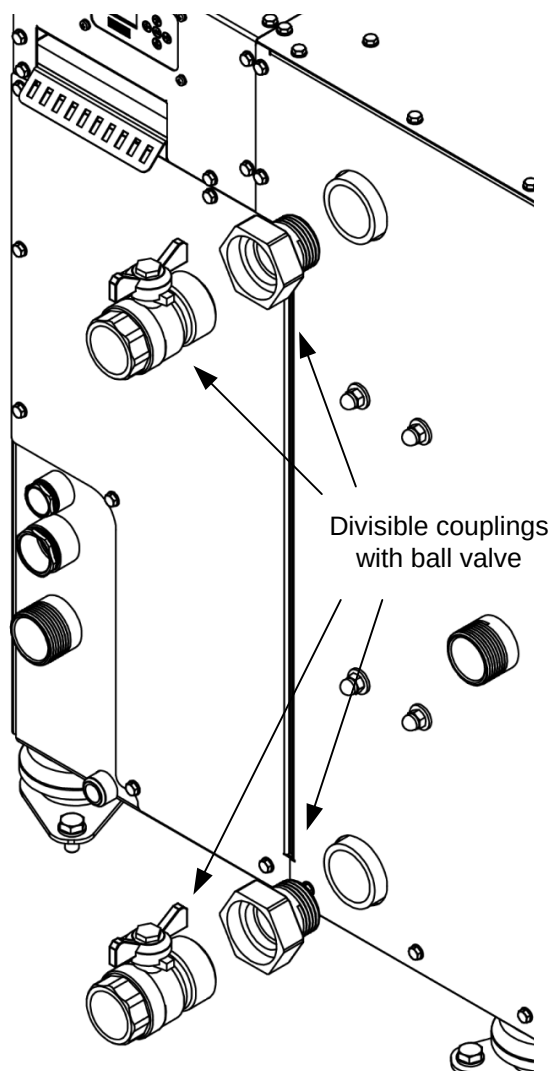


Chiller connections

We advise to connect the chilled water system as indicated on this page but there are many possibilities with different kind of materials.

Important is that the chiller unit is connected by an flexible connection to avoid that vibration of the unit is transferred to the fluid system through the boat.

Beside of this we advise to use divisible couplings on the chiller unit to make it possible to disconnect the chiller unit without empty the complete fluid system.



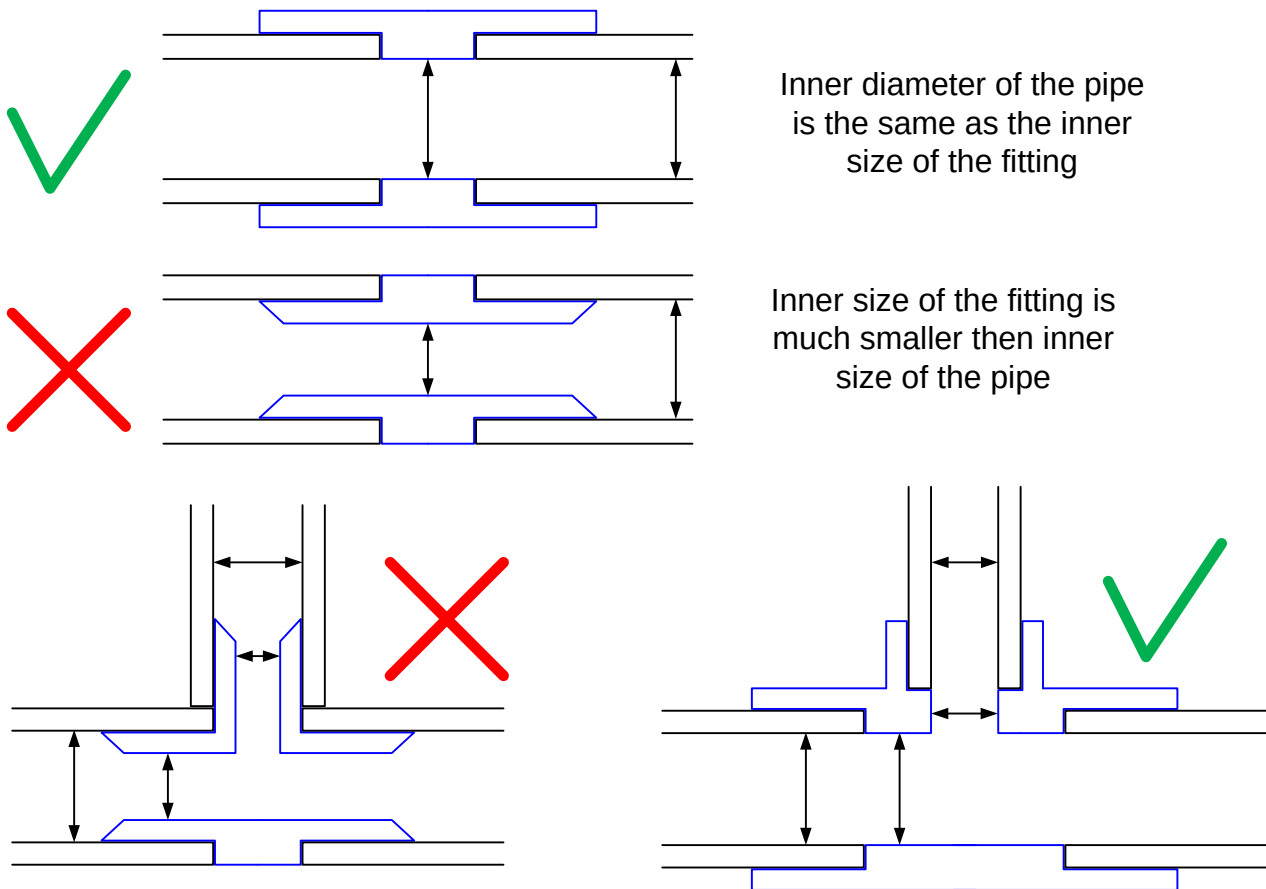
7. Fluid system.

Cold fluid from the chiller unit will be transported to the fan coil units by a piping system. To protect the equipment a glycol mixture must be used. By choosing a piping material it must be secured that the piping material is resistant against glycol and can handle temperatures between 2 and 40°C. If the system will be combined with a water heater the piping should be resistant against temperatures up to 80°C.

Materials which can be used is PVC-U (Cooling only), PVC-C, copper, stainless steel. If you Have any doubts about which material should be used, please contact us.

Beside the type of material it is important that a piping system is choosen with an equal size inner structure. This mean that the inner size of the pipe is equal or almost equal to the used fittings or valves.

See as example below.



Fittings with a high reduction of the diameter increase the sound of the fluid because of the high velocity inside of the fittings. Because of the pressure loss in every fitting the flow is affected adversely.

It will be advised that a calculation of the fluid system piping is made before installation. This to secure the right piping diameters. Normally we advise the fluid system with a maximum fluid velocity of 1.5m/sec.

Protect the fluid system against condensation. Piping, fittings and valves must be insulated!

8. Cooling water system

The chiller unit is a (sea) water cooled air-conditioning system. This means that heat from the boat will be transferred to the (Sea) water by the cooling process.

For the A15 we advice to use a water system with an internal diameter of 32mm. Piping, fittings and valves should be resistant to sea water and to a temperature of 50°C.

Connections on the chiller units should be made with anti vibration connections so that vibrations from the chiller unit will not be transferred to the boat.

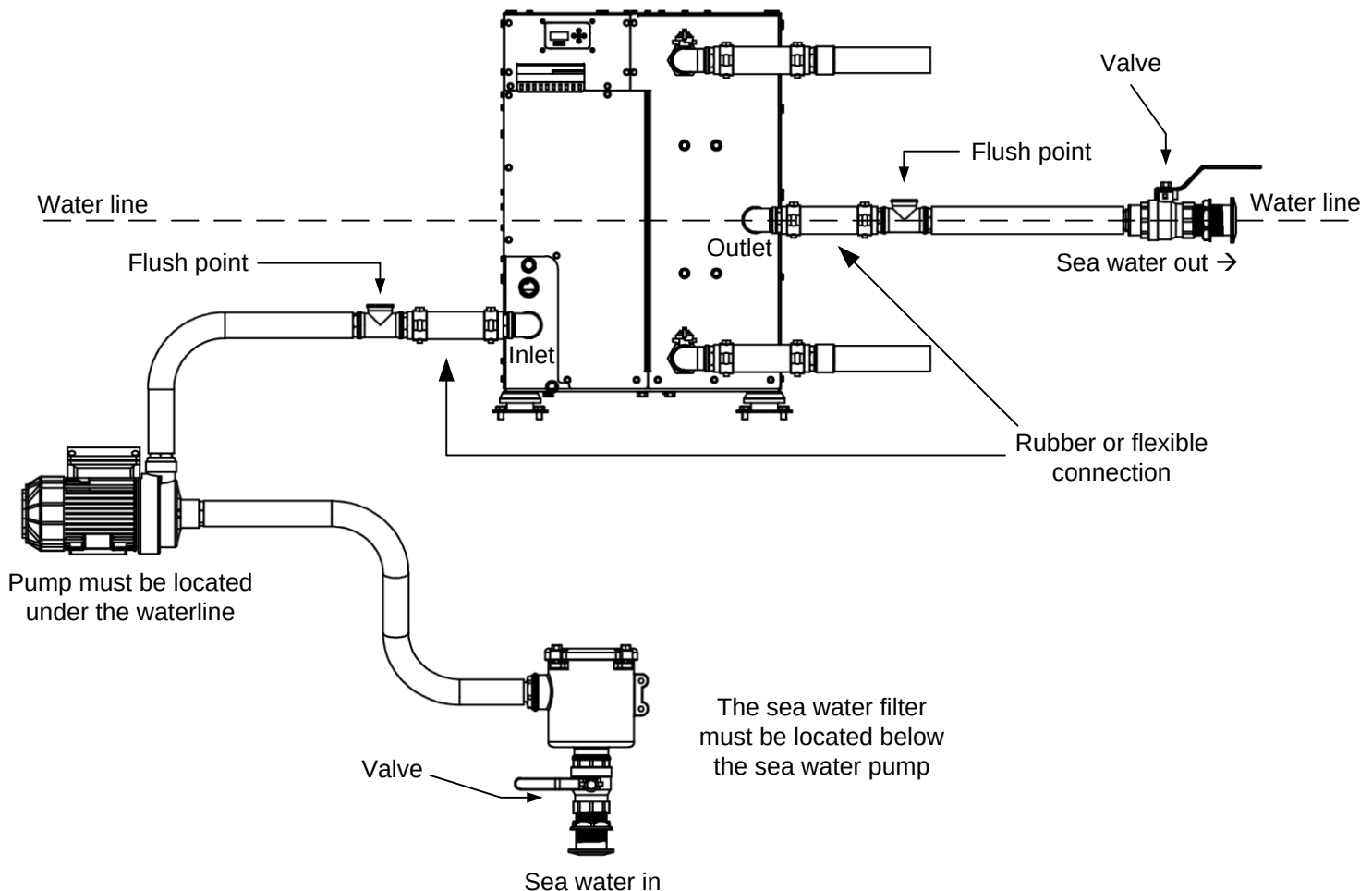
The sea water pump must always be mounted in a horizontal position as indicated below and located under the water line. The sea water supply should be made in a position where the sea water is always available. This means also during sailing and/or glide by fast motor boats.



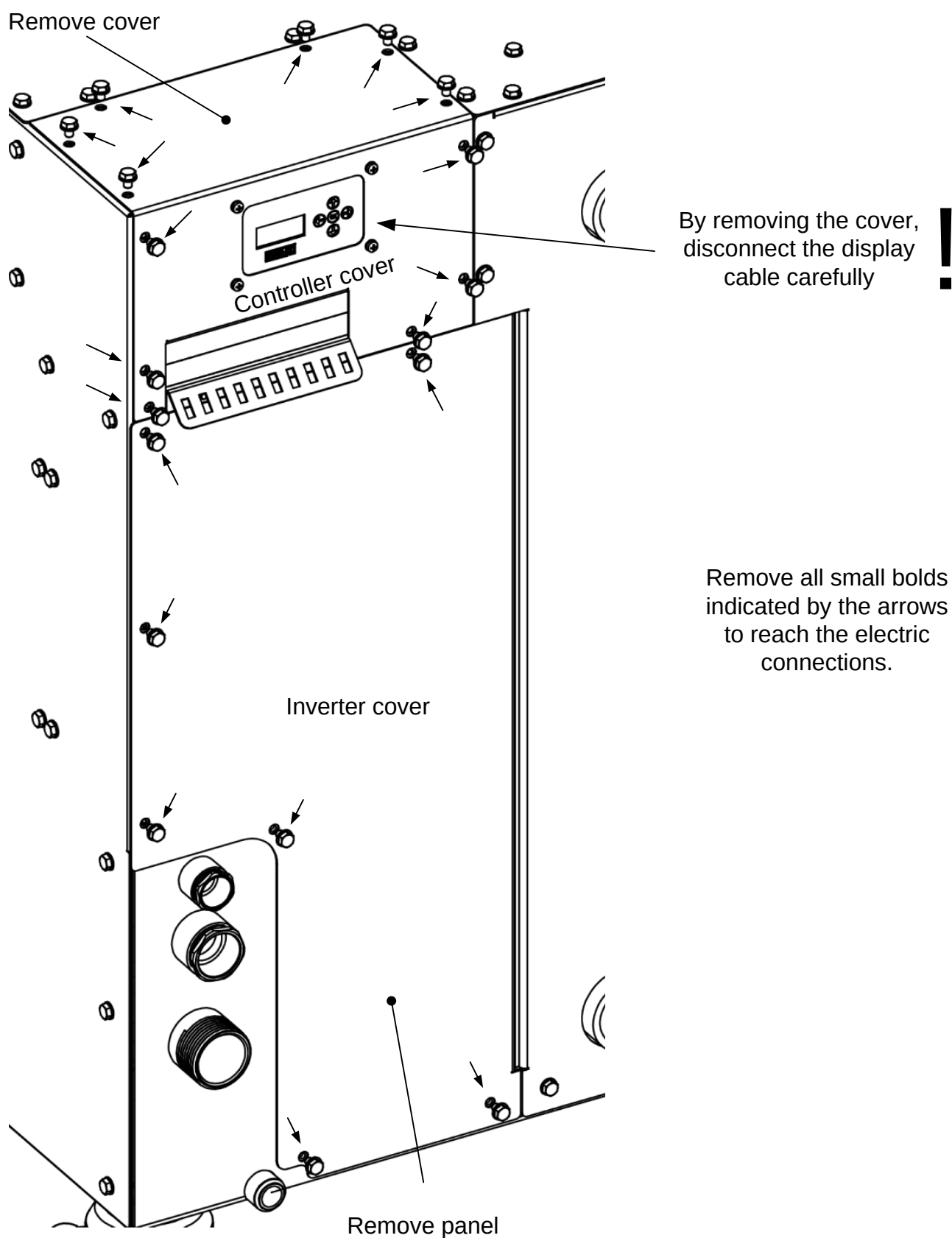
Do not install the sea water suction point near the water outlet of toilets.

Make sure that the sea water cooling system is installed in a way that no air blocks are possible in the system.

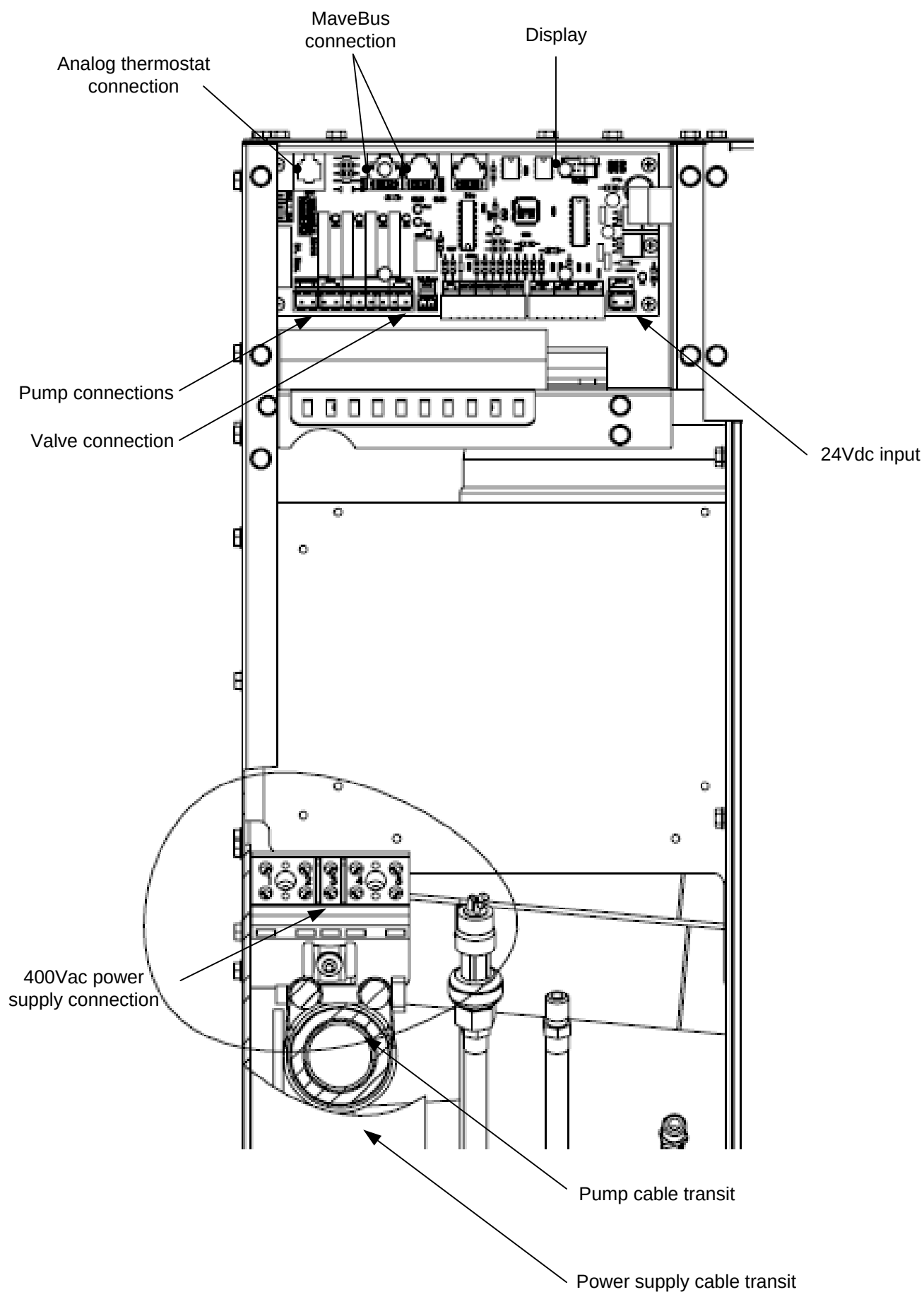
Chiller unit can be placed under or above the water line as long as the sea water inlet is above the sea water pump



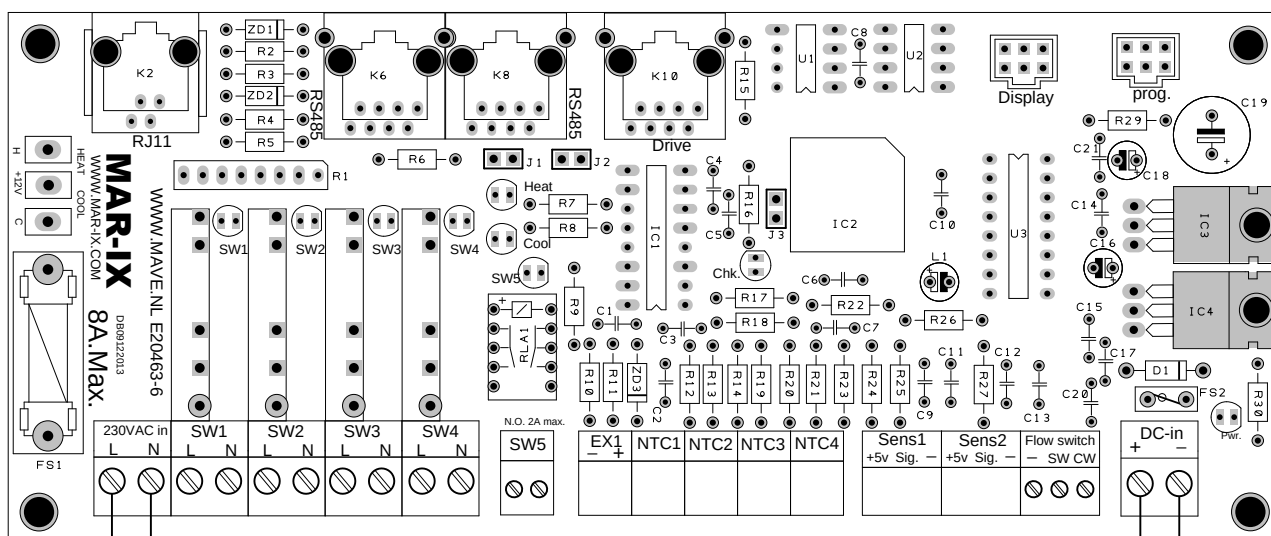
9. Electric connection locations



10. Electric connections



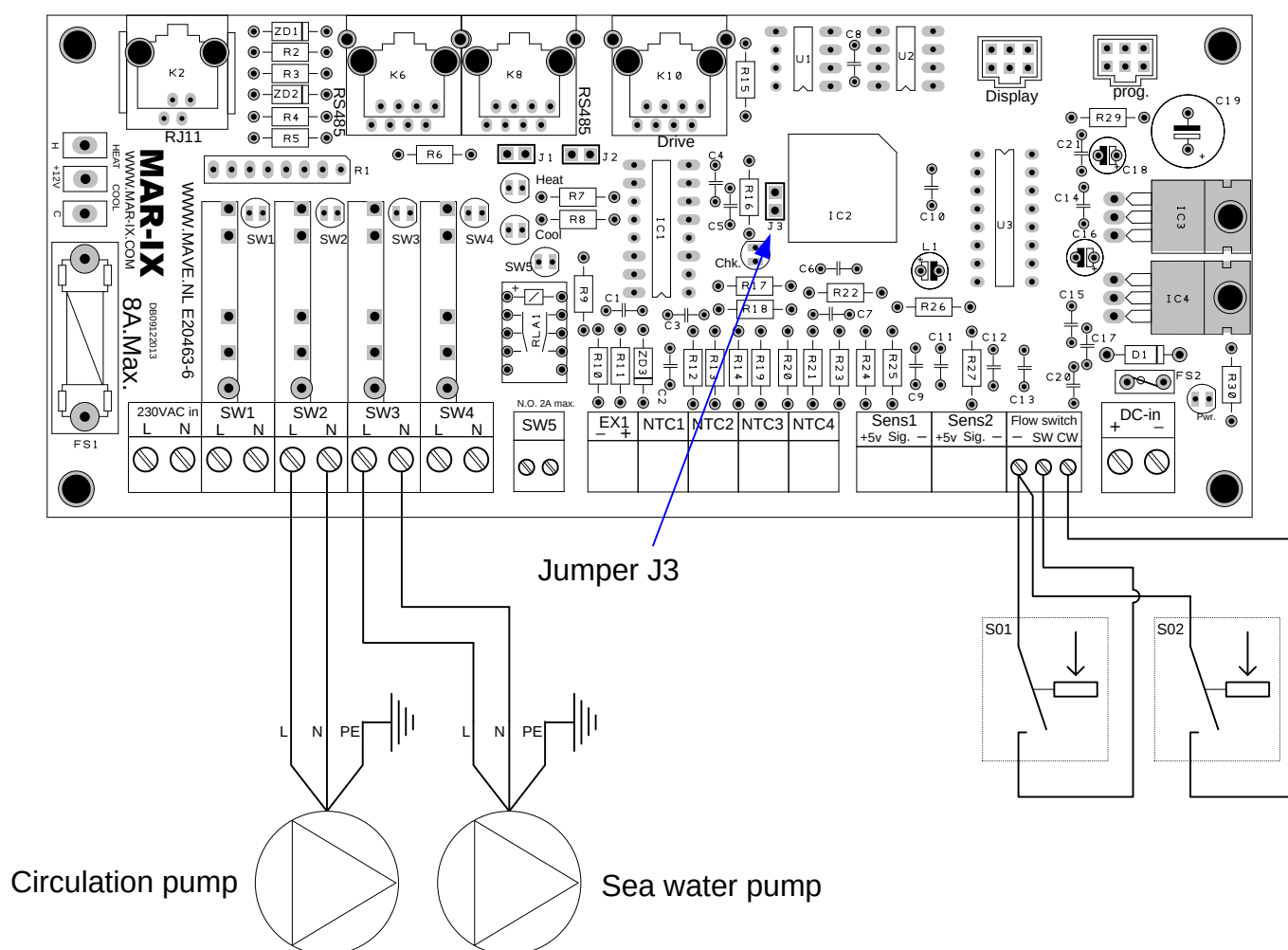
11. Electric connections power supply



230Vac input is internally
supplied from main power
supply

24Vdc connection on the
PCB must be connected to
a 24Vdc supply

12. Electric connections pumps and flow switches



Circulation pump;

This pump will always run when the chiller is activated even when the water will reach the set temperature.

Standard this pump will only run in cooling mode. If jumper **j3** is placed the circulation pump will also run in heating mode. (If flow is needed for an external heater)

Pump is running 1 minute after the chiller is switched to the standby modus.

If a flow switch is installed in the fluid line, the pump starts and runs for 20 seconds. If the flow switch is not closed within 20 seconds the pump will be switched off again. The compressor will not start before the flow switch is closed. Standard the flow switch connection is bridged from the factory.

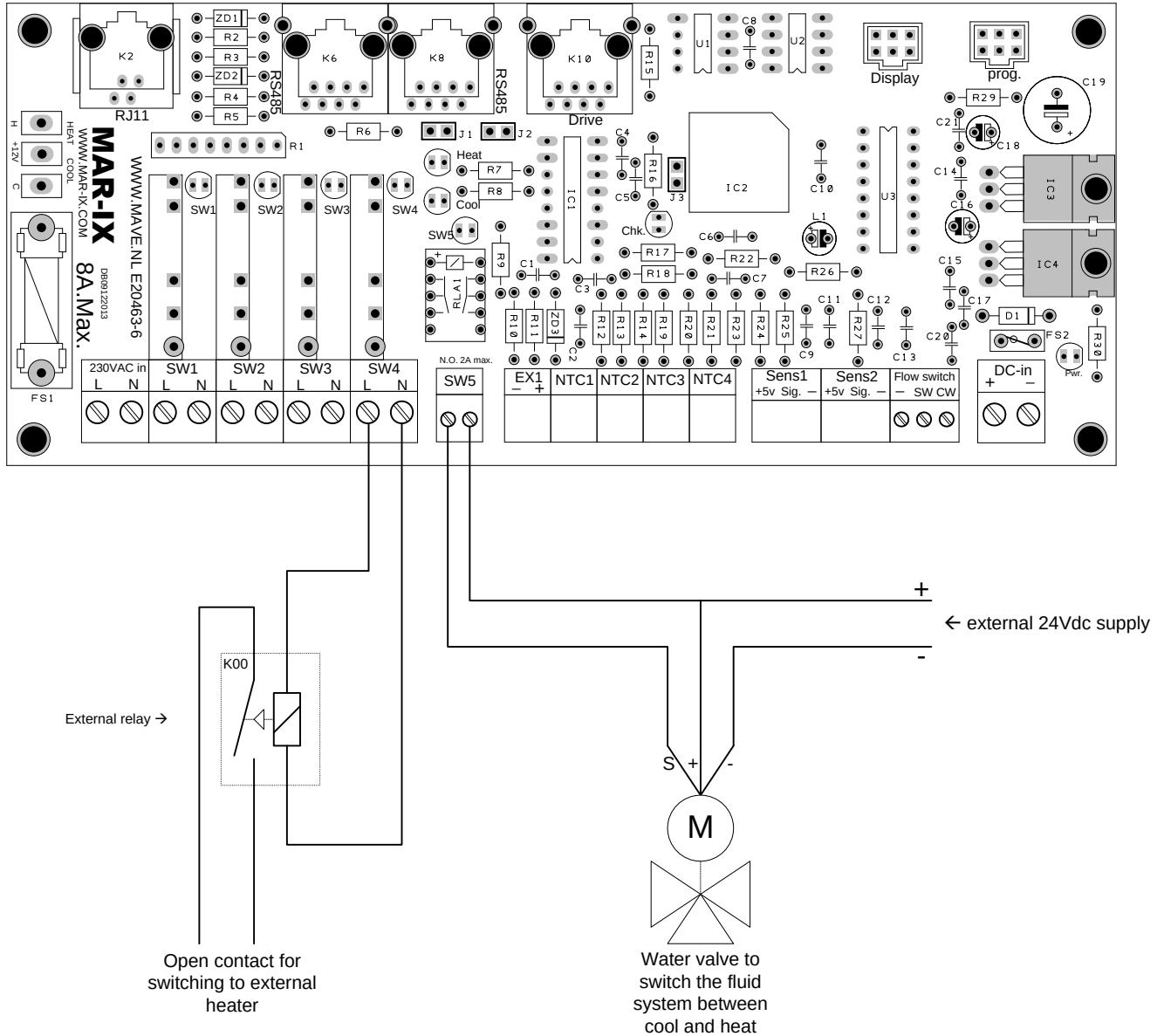
Sea water pump;

The sea water pump is only activated when the compressor is running. The pump runs 1.5 minutes after the compressor is switching off.

If a flow switch is installed in the sea water line, the pump starts and runs for 20 seconds.

If the flow switch is not closed within 20 seconds the pump will be switched off again. The compressor will not start before the flow switch is closed. Standard the flow switch connection is bridged from the factory.

13. Electric connections external heater and valve



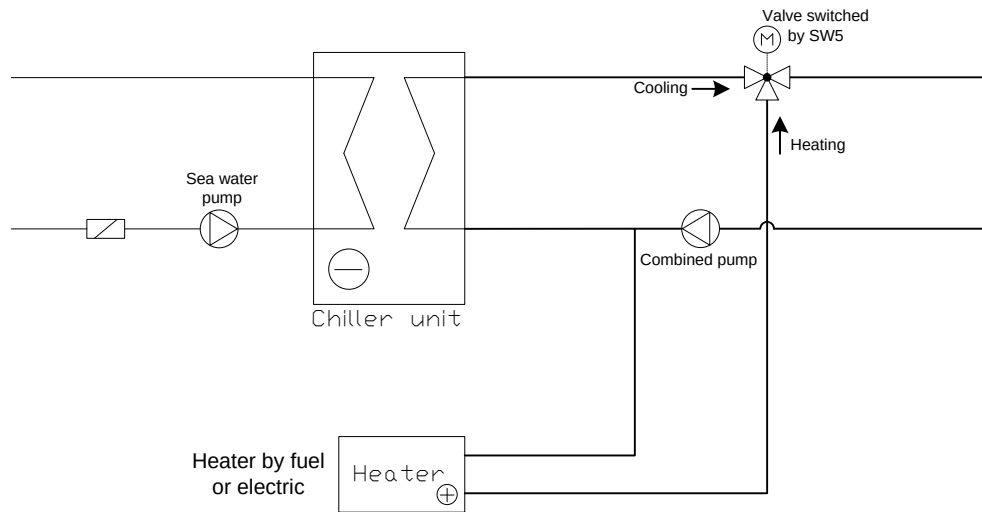
Heater output;

It is possible to control an external heater with the electronics of the chiller unit. If the heat function will be activated the circulation pump and the heater output will also be activated.

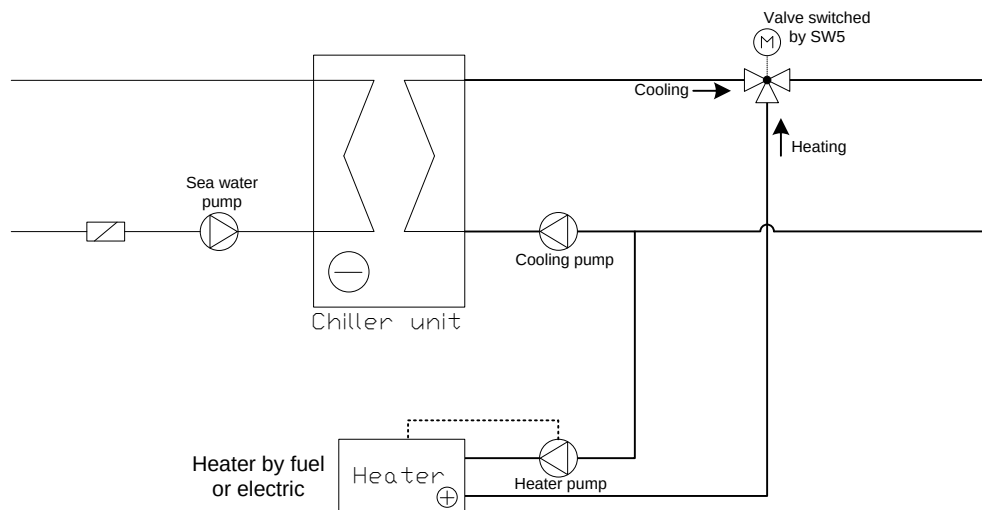
Valve output;

If the fluid system to the fancoilunits is combined for cooling and heating it is possible to use a valve to switch over from the chiller to an external heater. The sw5 output can be used to switch a 12-24Vdc signal. It is not possible to switch a 230Vac signal with this. Valve output will be activated for 3 minutes after switch off the heat function to cool down the heater unit.

Combined cooling heating set up



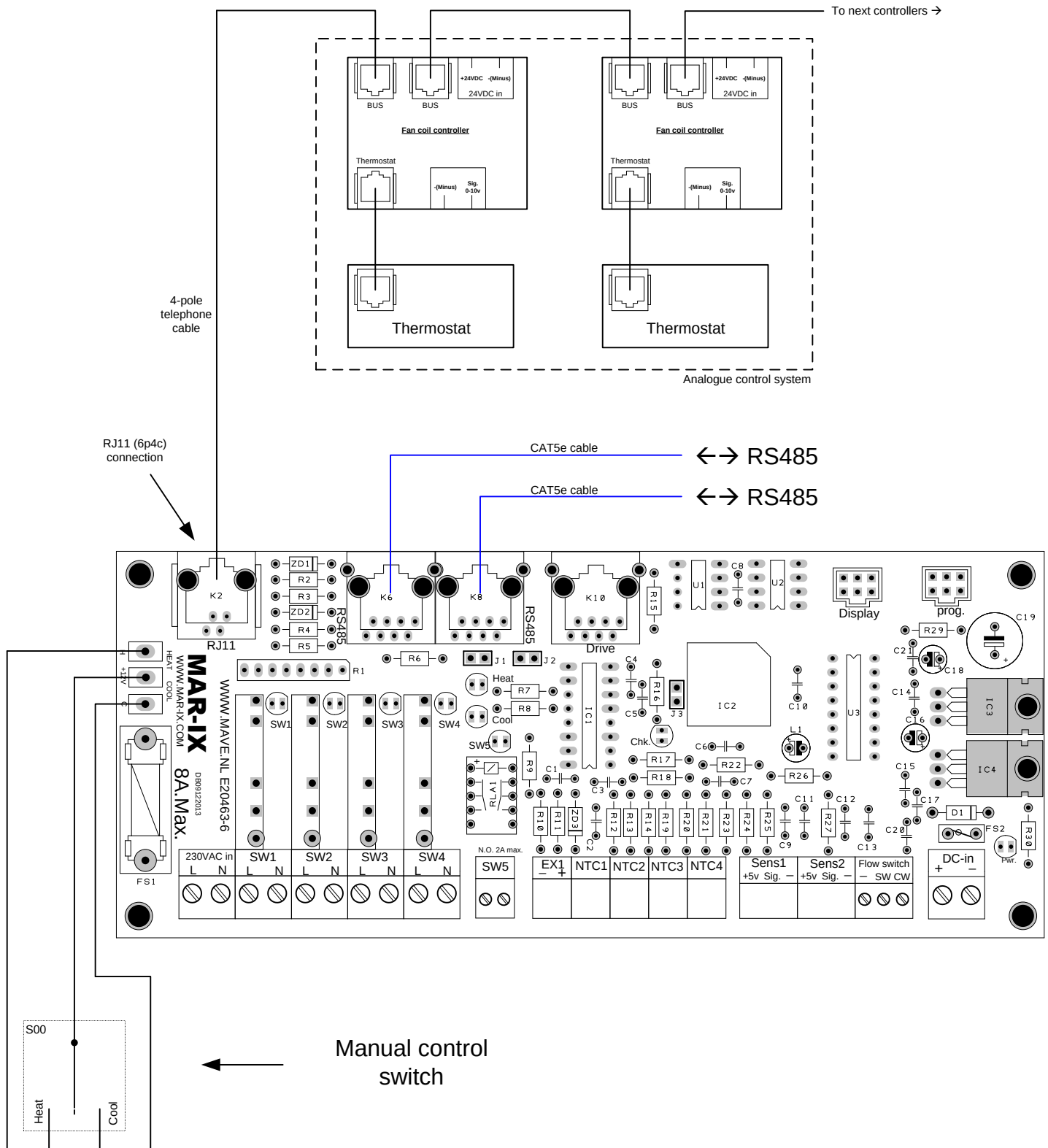
Combined circulation pump for cooling and heating



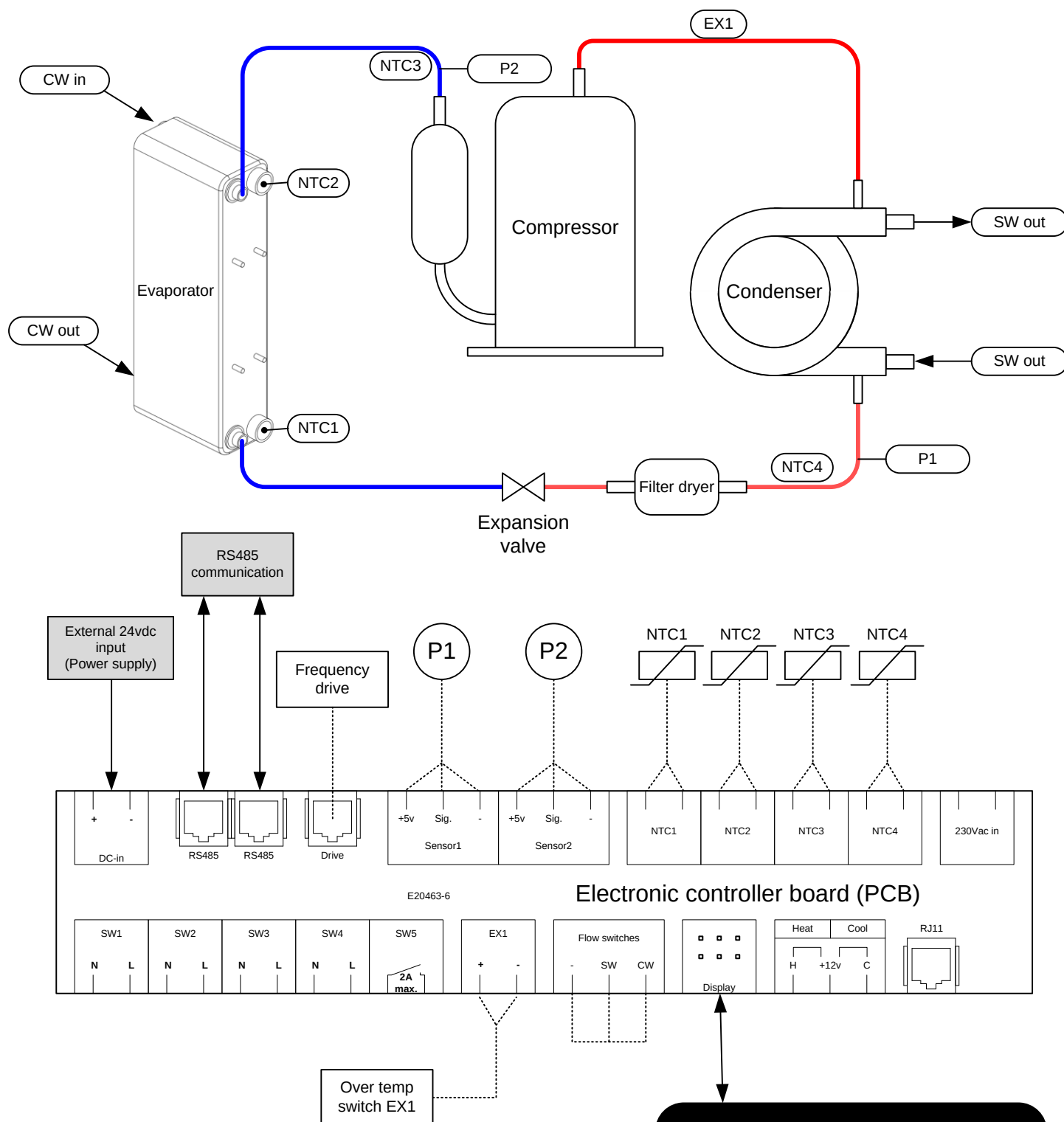
Separate circulation pump for cooling and heating.
Heater pump will be switched by heater

14. Electric control connections

It is possible to control the chiller unit in 3 ways. 1) Directly to our analogue thermostat system, 2) By RS485 through our master controller or 3) by manual switch over switch. It is not possible to use the analogue control and RS485 control together. If the RS485 control is used it is possible to use the manual switch as a back-up switch. The manual switch overrules the RS485 control.

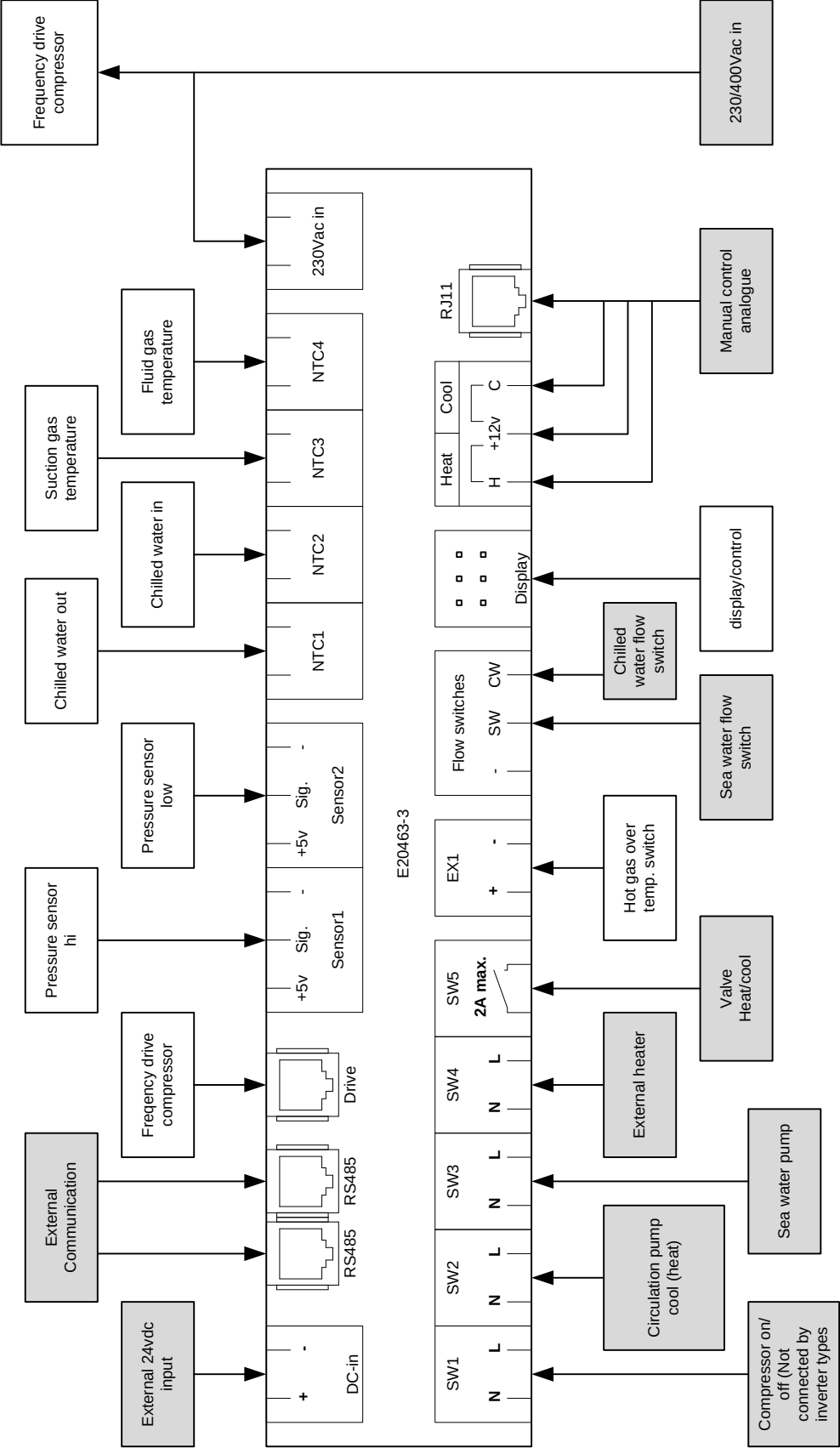


Internal electric details



- NTC1 = Temperature sensor chiller water out
- NTC2 = Temperature sensor chiller water in
- NTC3 = Temperature sensor refrigerant suction temperature
- NTC4 = Temperature sensor refrigerant fluid temperature
- EX1 = Overtemperature switch hot gas.
- P1 = High pressure sensor
- P2 = Low pressure sensor

Chiller electric overview



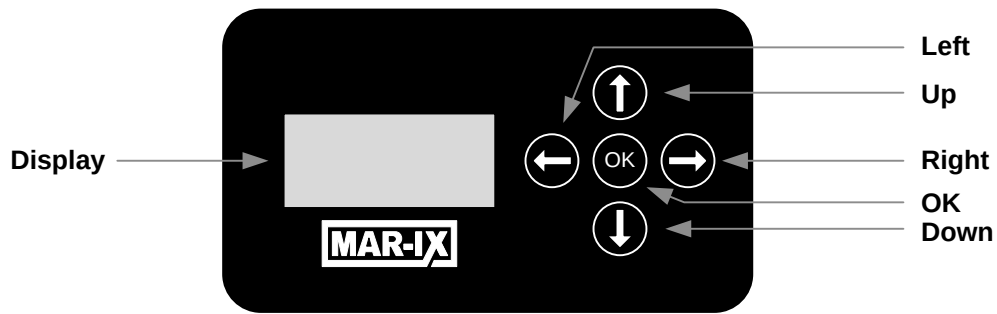
Grey = external connection/
component

White = internal connection/
component

Only standard connections are showed.
If the chiller unit is connected to a master controller the pump
configuration can be deviate. Check the custom made electric diagram
for the real configuration on board.



15. Display settings



The display contains readable data of the actual status of the chiller unit which are not changeable. These data is marked with R (Read only). Settings are changeable and marked as R/W (Read and write)
By pressing the up/down button the menu items will be showed starting from item 1.

The display is protected against item changes. Please contact factory if changes should be made.

Item 2 (R/W)

If the chiller unit is connected to the MAVEBUS RS485 circuit this number has to be filled in. Make sure that every chiller unit has it's own unique number.

Item 3 (R)

This shows the incoming chilled water temperature. (NTC2)

Item 4 (R)

This shows the outgoing chilled water temperature. (NTC1)

Item 5 (R)

This shows the temperature of the suction side of the refrigerant system. (NTC3)

Item 6 (R)

This shows the temperature of the fluid side of the refrigerant system after the condenser. (NTC4)

Item 7 (R)

This shows the pressure of the suction side of the refrigerant system. (Low pressure sensor P2)

Item 8 (R)

This shows the pressure of the High pressure side of the refrigerant system. (High pressure sensor P1)

Item 9 (R/W)

This parameter can be set for the temperature that the compressor switch on again after switching off. This temperature is measured from the incoming water temperature.

Item 10 (R/W)

This parameter can be set for the temperature that the compressor switch on again after switching off. This temperature is measured from the incoming water temperature.

Item 11 (R/W)

With this item the minimum refrigerant pressure can be set. This pressure is measured on the low pressure side of the refrigerant system. Below the set pressure the compressor will switch off.

Item 12 (R/W)

With this item the maximum refrigerant pressure can be set. This pressure is measured on the high pressure side of the refrigerant system. Above the set pressure the compressor will switch off.

Item 13 (R)

In this item the maximum pressure from the refrigerant pressure Sensor is set.

Item 14 (R/W)

Start up delay. The delay between the compressor switched off and on.

Item 15 (R/W)

With this item the minimum suction temperature can be set. Under this temperature the display shows an error

Item 16 (R/W)

With this item the maximum temperature of the refrigerant fluid can be set. Above this temperature the compressor will regulate the capacity down.

Item 17 (R)

In this item the running minutes can be read.

Item 18 (R)

In this item running time can be read. 1 is 1092hours + item 29 in minutes is the total running time.

Item 19 (R)

See fault register below.

Fault Error

- | | |
|-----|--|
| 51 | High pressure sensor out of range |
| 52 | Low pressure sensor out of range |
| 53 | Hot gas over temperature |
| 102 | Short circuit in temperature chilled water in sensor (NTC2) |
| 103 | Open circuit in temperature chilled water in sensor (NTC2) |
| 104 | Short circuit in temperature chilled water out sensor (NTC1) |
| 105 | Open circuit in temperature chilled water out sensor (NTC1) |

Item 20 (R/W)

In this item the type of frequency inverter can be select. Without inverter this item should be on none

Item 21 (R/W)

In this item the reaction time of the compressor can be select. 0 is a fast speed change, higher reaction number will give a slower reaction of compressor speed change.

Item 22 (R)

In this item the software version can be read out.

16. Maintenance

After the chiller unit(s) is commissioned a regular check is preferred to keep the chiller(s) in reliable condition.

Written interval for maintenance is an indication, depending on surrounding circumstances, and running hours. By experience the maintenance interval should be chosen.

Run the complete system at least one times a month to keep the pumps and other rotating equipment in optimal condition. A long term of not running the system can result in blocked pumps and growing pollution of the sea water system.

Check daily the next points;

-Outside the chiller unit on fluid leakage from/between fluid connections of the sea water and chilled water system. Leakage of fluids above/around the chiller unit(s) from other systems on board.

-Abnormal sounds.

-Water pressure in the chilled water system.

-Sea water filter against pollution.

Maintenance every 3 months;

-Flush the sea water system to remove barnacles and calcic out of the sea water piping and condensers. See Page 26.

Check the refrigerant pressure on the control display or the touch screen. See Page 21.

Instructions for cleaning/flush the sea water system.

The wall temperature of the condenser can reach temperatures up to 100°C therefore it is possible that lime will precipitate on the inside surface. Because lime has a bad heat transfer coefficient the efficiency of the chiller unit will decrease and a higher pressure in the high pressure side of the refrigerant system will arise. Mostly a polluted condenser can be recognized that the refrigerant high pressure side is rising up by period.

By making a maintenance plan and note periodically the high pressure value a polluted condenser can be observed. It is important to always compare the noted pressure in combination with the sea water temperature. A higher seawater temperature will also result in a higher pressure. The interval for cleaning the condensers depends on the circumstances, running hours and quality of the sea water.

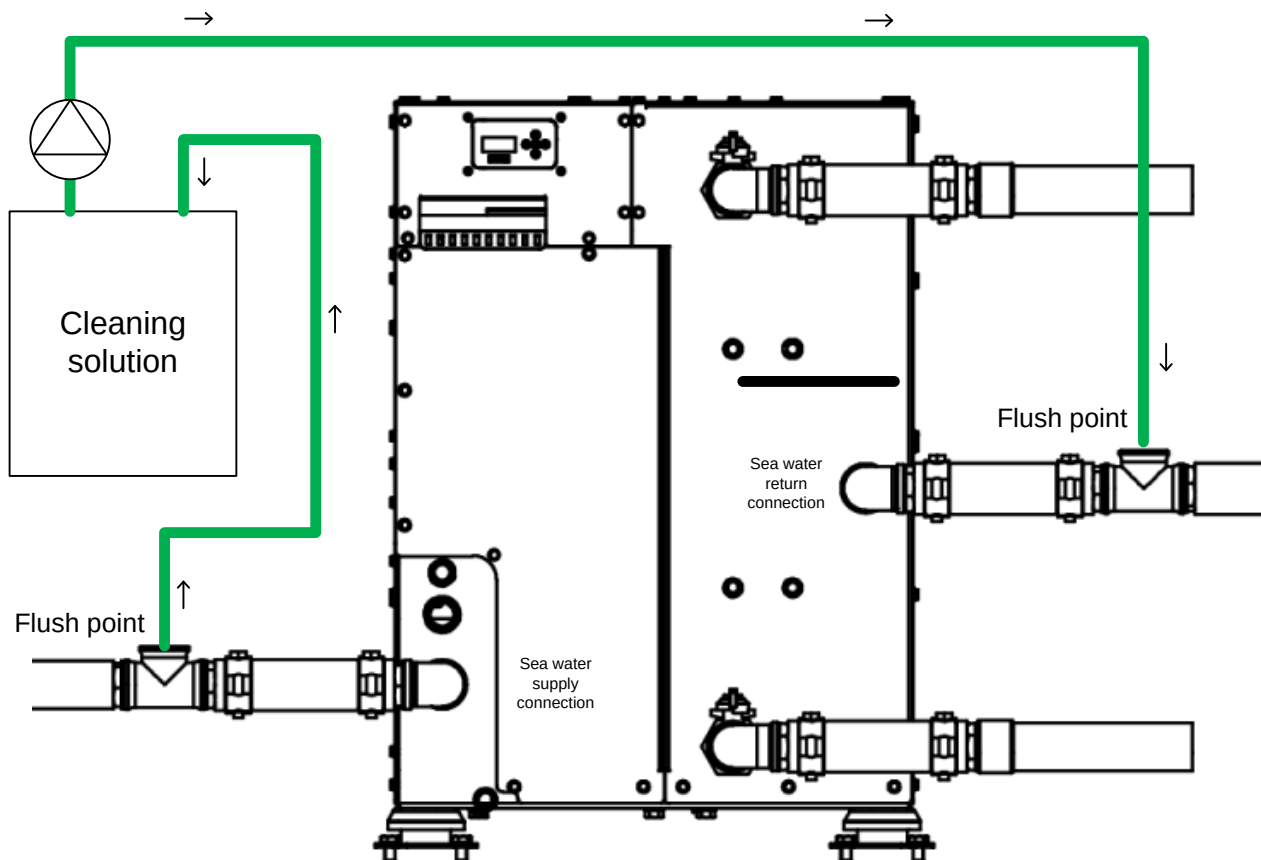
How to do; (See also drawing on the next page)

- Note the sea water temperature and high pressure value of the refrigerant during operation of the system to compare the values after cleaning.
 - Every kind of cleaning solution can be used as it indicated on the specifications that it is suitable for this purpose. The solution **should not** damage or being aggressive to copper (Copper/Nickel) stainless steel and rubber.
- Wear personal safety materials to protect yourself against aggressive fluids. Avoid splashing with the solution to protect equipment around the working area.
- Switch off the power supply and close the sea water supply and return valve. Remove the supply and return connection from the chiller unit. If more chillers are connected with each other the main connection can be disconnected. If a flush connection is installed by the installer/shipyard it can also be used.
 - Connect a solution pump to the sea water system as indicated on the next page.
 - Flush in the opposite direction from the normal sea water flow for around 15 minutes. Check visually the pollution in the solution.
 - Disconnect and drain the system from the solution.
 - Flush the system with fresh water.

Be aware that most cleaning solutions are bad for the environment. Don't flush solutions overboard!!

- After flushing connect the sea water connections in its original position.
- Open the sea water valve(s) and start up the system.
- Check all connections on leakage.
- Note the sea water temperature and high pressure value again.

On the basis of all the collected data over a period of time a log can be made to set up a accurate maintenance schedule.



Example of flushing/cleaning the sea water system.



Instructions for maintenance on the refrigerant system.

The refrigerant system of the A15 unit is a system with a hermetic closed compressor. Maintenance/repair of the refrigerant system should only be done by certified persons with knowledge of this kind of equipment.

Refrigerant systems operate under high pressure and during running it contains hot parts inside.

The refrigerant system is filled with refrigerant inside which is not necessary to change or replace for maintenance. It can be used for the lifespan of the chiller unit.

Only by a defect of one of the cool technical parts the refrigerant should be removed. It is not possible to replace components of the refrigerant system without emptying the refrigerant system.

The system is equipped with refrigerant sensors, don't connect manual gauges to the check valves to measuring the refrigerant pressure. This only creates a loss of refrigerant.

What can be checked by non certified persons;

Switch of the chiller unit.

To check if the quantity inside the system is sufficient the "inverter cover" has to be removed. Wait until the chilled water system is far above normal working conditions ($\pm 15-20^{\circ}\text{C}$). Start up the chiller unit and wait until the chiller runs around maximum speed. (Between 80 and 90Hz indicated on the frequency inverter)

The "Sign glass" should be clear and free of bubbles.



Protection of the system during winter conditions.

A chiller system contains fluid and can be damaged by freezing.

The chilled water system is filled with glycol or a water/glycol mixture and is normally protected against congelation.

Always check if the freezing level of the glycol is high enough comparing with the possible ambient temperature.

Replenish or refill the system to assure a certain safe freezing level if needed.

Run the whole system to be sure that the glycol is reaching or flowing through every component in the system.

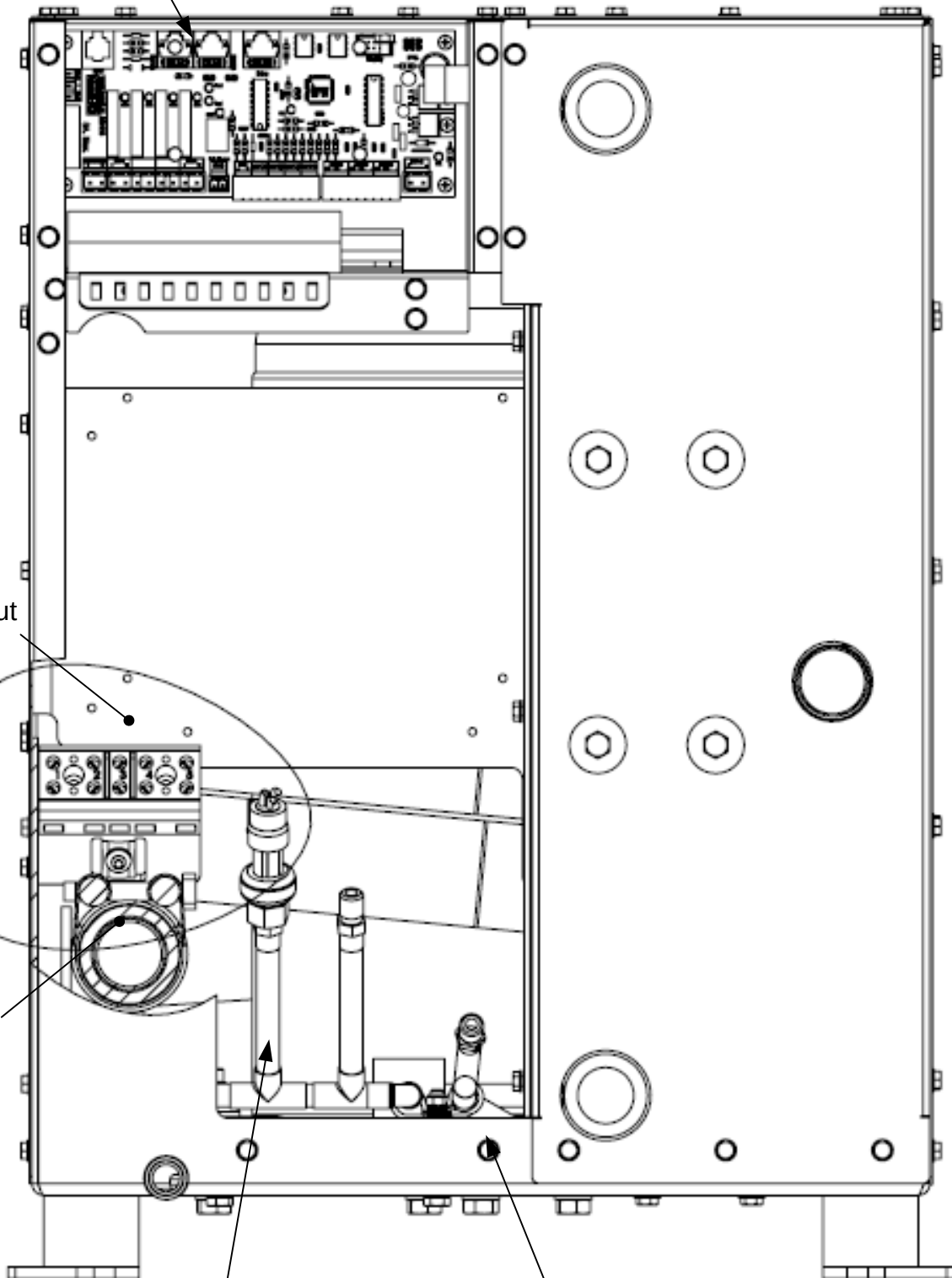
The sea water system is never protected because of the fresh or salt water inside.

Empty/drain the whole sea water system and fill it up with glycol to protect the system against freezing.

Make sure that the sea water system is protected from the water inlet through the hull up till the outlet through the hull.

17. Location components

Electronic controller board
(PCB)



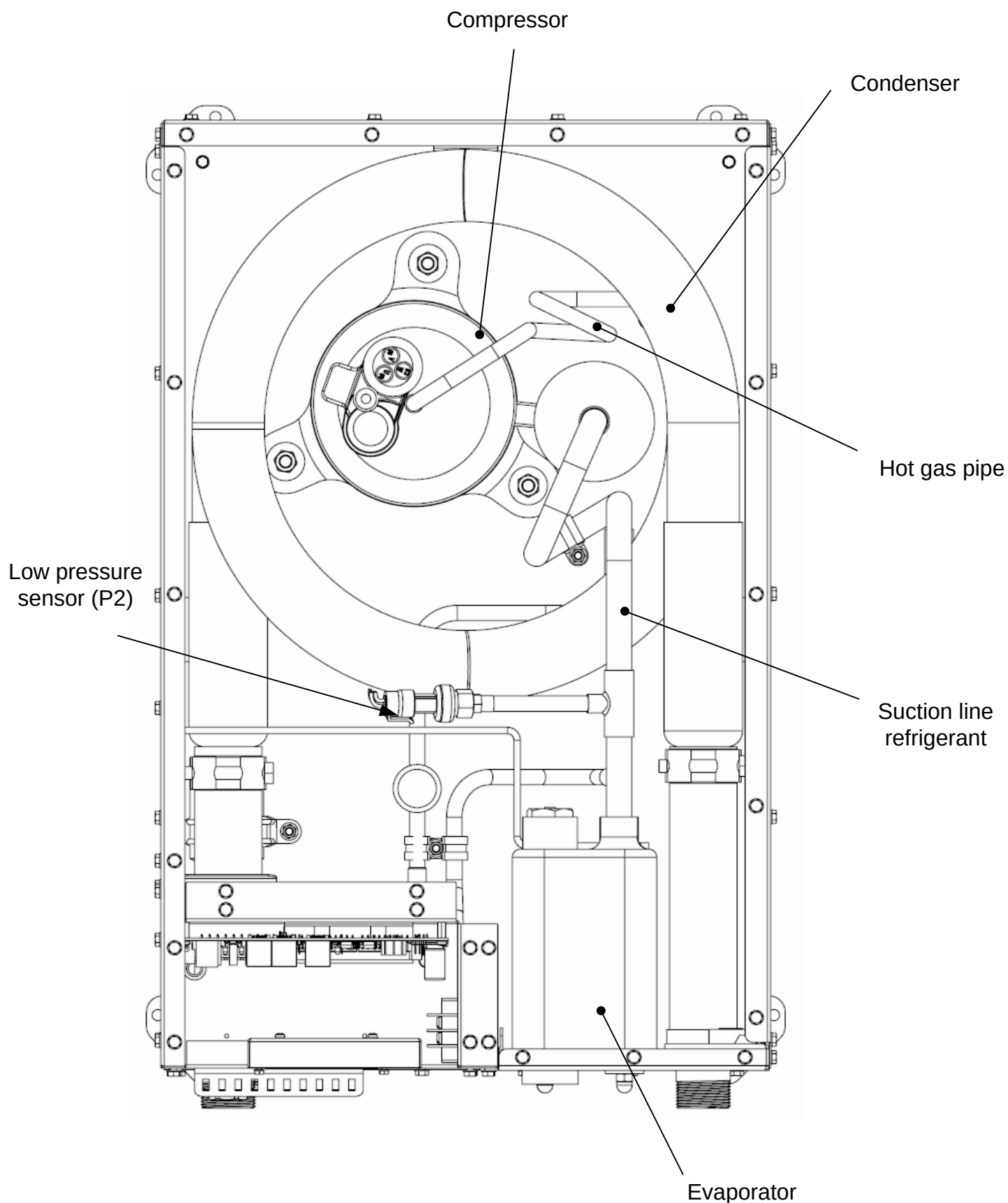
400Vac input

Cable transit
400Vac

High pressure sensor (P1)

High pressure check valve

Location components



18. Technical data

A15	
<i>Voltage</i>	400V/50Hz-AC
<i>Cool capacity</i>	15kW (51.000Btu)
<i>Refrigerant</i>	R410A
<i>Number of compressors</i>	1
<i>Current (compressor)</i>	6A (Nominal)
<i>Dimensions (lxwxh)</i>	593 x 380 x 530 mm
<i>Weight</i>	81 kg

19. Environmental Information

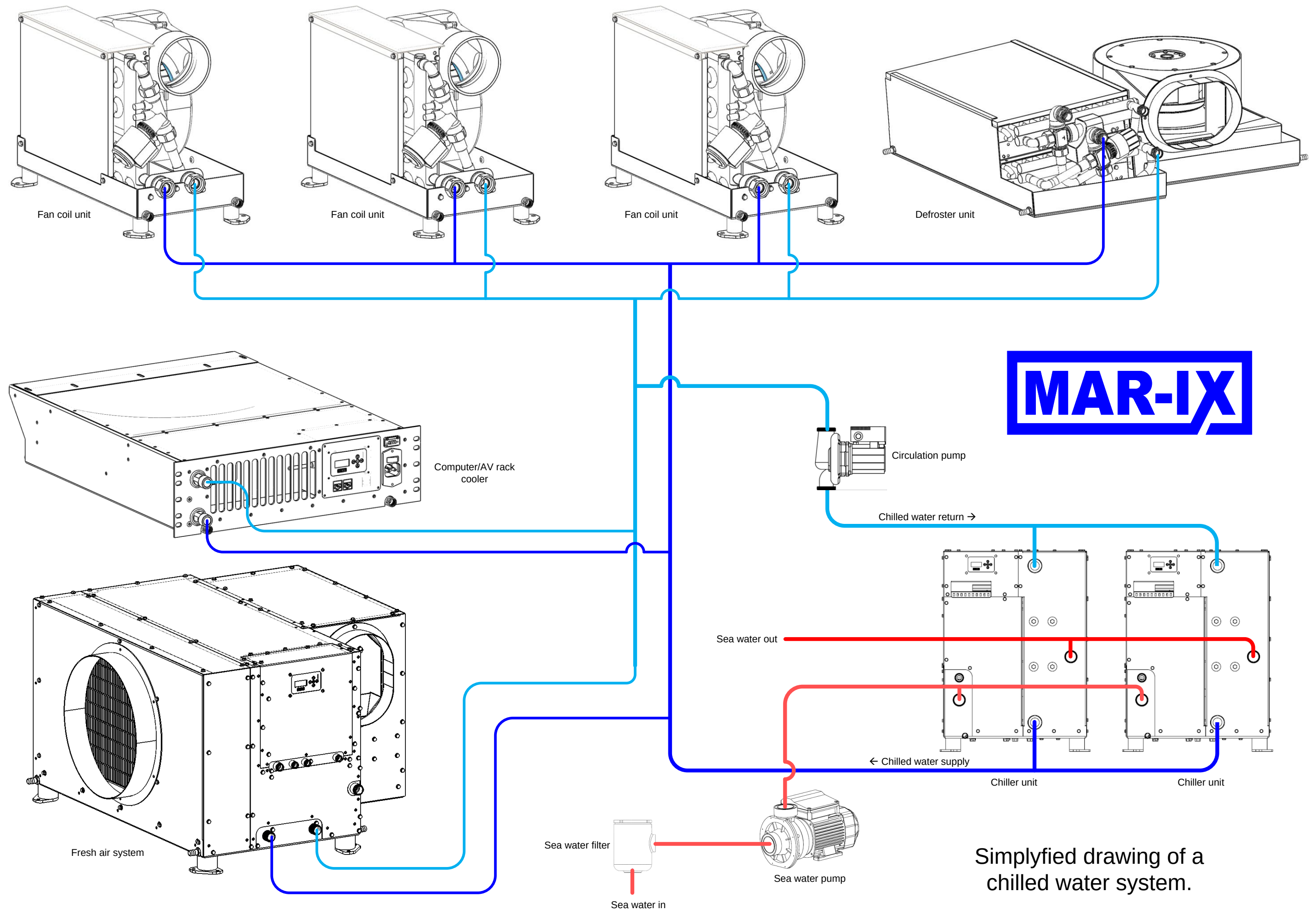
This product is manufactured from many recyclable materials. At the end of its useful life, it should be disposed of at a Local Recycling Centre in order to realise the full environmental benefits. It does not contain any substances harmful to health; it does not contain any asbestos.

Chilled fluid, which remains in the watercoil after dismantling should be processed in an environmentally friendly way.



Packing

Packing materials can be re-used for other purposes or can be retained in case the unit needs to be sent back.



Simplified drawing of a chilled water system.

EC Declaration of Conformity

Manufacturer

Mavé B.V.

Address

Loofklapper 14, 8256 SL, Biddinghuizen, The Netherlands

Product

Airco Chiller Unit - Series A, AIV, CIV & HC

MAVÉ BV, hereby declares
that the product series listed
above are designed and
manufactured in compliance
with the essential health and
safety requirements of the
following Directives.

- Machinery Directive 2006/42/EC
 - Low Voltage Directive 2006/95/EC
 - Electromagnetic Compatibility Directive 2004/108/EC
 - Pressure Equipment Directive 97/23/EC
-

*The harmonized technical
standards and the technical
standards to the conformity
assessment:*

- EN 12100 1&2, Safety of machinery
 - General principles for design
 - Risk assessment and risk reduction
- EN 14121-1, Safety of Machinery - Risk assessment
 - Principles
- EN 378 1&2, Refrigerating systems and heat pumps
 - Basic requirements, definitions, classification and selection criteria
 - Design, construction, testing, marking and documentation

Place and date of issue:
Biddinghuizen, 18-02-2015

*Name and signature of authorized
person*

Managing director Mavé B.V.



Pressure Test Certificate

Manufacturer	Mavé B.V.
Address	Loofklapper 14, 8256 SL, Biddinghuizen, The Netherlands
Product	Airco Chiller Unit - Series A, AIV & HC

Mavé B.V. the Netherlands, declares that all manufactured chillers and AC units have been tested and subjected to the following test procedures:

The complete installation has been pressure tested with dry N2 according to European and Dutch regulations. All units have been tested on at least 1.0 times the maximum working pressure with a maximum of 1.3 times the maximum working pressure. The design pressure of any component is not lower than the maximum working pressure of the refrigeration system or section of the system in which that component is used. During the testing period the installation has been checked on leakage and deformation.

Testing values

R410a units.

This testing pressure on the low pressure side was ≥ 2500 KPa(g) $\approx 43^{\circ}\text{C}$.

This testing pressure on the high pressure side was ≥ 2600 KPa(g) $\approx 43^{\circ}\text{C}$. (water cooled)

R407c units.

This testing pressure on the low pressure side was ≥ 1750 KPa(g) $\approx 43^{\circ}\text{C}$.

This testing pressure on the high pressure side was ≥ 1750 KPa(g) $\approx 43^{\circ}\text{C}$. (water cooled)

R134a units.

This testing pressure on the low pressure side was ≥ 1000 KPa(g) $\approx 43^{\circ}\text{C}$.

This testing pressure on the high pressure side was ≥ 1000 KPa(g) $\approx 43^{\circ}\text{C}$. (water cooled)

Vacuum test.

Installations with a refrigerant charge < 10 kg. A vacuum test has been performed by a vacuum of < 270 Pa and a minimal holding period of 30 minutes.

Place and date of issue:
Biddinghuizen, 18-02-2015

Name and signature of authorized
person

Managing director Mavé B.V.



Test Certificate

Manufacturer Mavé B.V.

Address Loofklapper 14, 8256 SL, Biddinghuizen, The Netherlands

Product **Airco Chiller Unit - Series A, AIV & HC**

Mavé B.V. the Netherlands, declares that all manufactured chillers and AC units have been tested comprehensively and are all subjected to a full function test.

The function test have been carried out in the Mavé test facility.

Test parameters

R410a units.

This testing pressure on the low pressure side was ≥ 2500 KPa(g) $\approx 43^{\circ}\text{C}$.

This testing pressure on the high pressure side was ≥ 2600 KPa(g) $\approx 43^{\circ}\text{C}$. (water cooled)

R407c units.

This testing pressure on the low pressure side was ≥ 1750 KPa(g) $\approx 43^{\circ}\text{C}$.

This testing pressure on the high pressure side was ≥ 1750 KPa(g) $\approx 43^{\circ}\text{C}$. (water cooled)

R134a units.

This testing pressure on the low pressure side was ≥ 1000 KPa(g) $\approx 43^{\circ}\text{C}$.

This testing pressure on the high pressure side was ≥ 1000 KPa(g) $\approx 43^{\circ}\text{C}$. (water cooled)

Leaktest

During the functional test a leaktest on all pressurised refrigeration piping is performed with use of leaktester: *Testo 316-4*.

Place and date of issue:
Biddinghuizen, 17-02-2015

Name and signature of authorized person



Managing director Mavé B.V.





Loofklapper 14 - 8256 SL Biddinghuizen - The Netherlands
Tel.: +31(0)321-337467
Web: www.mave.nl - Email: info@mave.nl